OFFICE OF NAVAL RESEARCH

END-OF-YEAR REPORT

PUBLICATIONS/PATENTS/PRESENTATIONS/HONORS/STUDENTS REPORT

For

1 August 1987 through 30 June, 1988

For

Contract N00014-85-K-0899

Code 1513A:DHP

NEW CONDUCTING POLYMERS

Bernard Gordon III, James P. Runt and Paul C. Painter

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Part I

a. Papers Submitted to Refereed Journals

NONE

b. Papers Published in Refereed Journals

B. Gordon III and L. F. Hancock, "Proton Abstraction as a Route to Electrically Conducting Polymers", *Polymer* **1987**, 28(4), 585.

c. Books (and sections thereof) Submitted for Publication

NONE

d. Books (and sections thereof) Published

NONE

e. Technical Reports Published and Papers Published in Non-Refereed Journals

P. J. Hans and B. Gordon III, "Wittig Synthesis or Conductive Segmented Block Polymer Compositions" *Polymer Preprints*, **1987**, 28(2), 310.

B. L. Hilker, J. A. Hancock, L. F. Hancock and B. Gordon III, "Nitro-stabilized Proton Abstraction Doped Model Compounds as Precursors to Conducting Polymers" *Polymer Preprints*, **1987**, 28(2), 314.

L. F. Hancock and B. Gordon III "Conductive Materials Based on Delocalized Anions" *Polymer Preprints*, **1987**, 28(2), 312.

f. Patents Filed

NONE

g. Patents Granted

NONE

h. Invited Presentations at Topical or Scientific/Technical Society Conferences

B. L. Hilker, P. J. Hans, L. F. Hancock, and B. Gordon III, "Studies in Conducting Polymers: Proton Abstraction to Delocalized Carbanions", 22nd Middle Atlantic Regional Meeting of the American Chemical Society, symposium on High Performance Polymers, May 24, 1988.

i. Contributed Presentations at Topical or Scientific/Technical Society Conferences

P. J. Hans and B. Gordon III, "Wittig Synthesis or Conductive Segmented Block Polymer Compositions" Polymer Chemistry Division, American Chemical Society, August 1987.

B. L. Hilker, J. A. Hancock, L. F. Hancock and B. Gordon III, "Nitro-stabilized Proton Abstraction Doped Model Compounds as Precursors to Conducting Polymers" Polymer Chemistry Division, American Chemical Society, August 1987.

L. F. Hancock and B. Gordon III "Conductive Materials Based on Delocalized Anions" Polymer Chemistry Division, American Chemical Society, August 1987.

j. Honors/ Awards/ Prizes

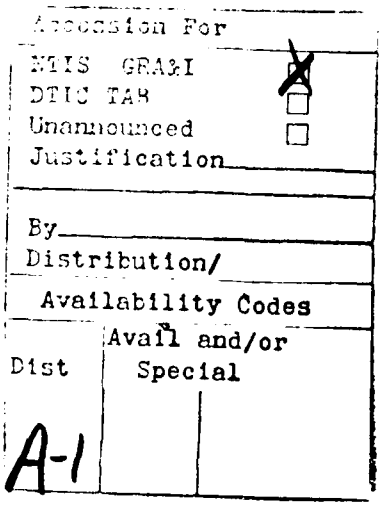
NONE

k. Number of Graduate Students Receiving Full or Partial Support on ONR Contract

Graduate Students - 3

l. Number of Postdoctoral Fellows Receiving Full or Partial Support on ONR Contract

NONE



Part II.

a. Principal Investigators

Bernard Gordon III, James P. Runt and Paul C. Painter

b. Cognizant ONR Scientific Officer.

Dr. Kenneth J. Wynne Code 7A720

c. Current Telephone number.

(814) 863-3457

d. Brief Description of Project.

Conducting polymers, in the n-doped state, have the proposed structure of totally delocalized carbanions. These are produced by the reduction of totally conjugated polymers. An alternative route to polymeric delocalized carbanions is through proton abstraction from methylenes which are doubly allylic and/or benzylic and placed periodically along the polymer backbone. Polymers, oligomers and model compounds of this general type are currently being prepared. Proton abstraction is being carried out with strong base. To stabilize the delocalized carbanion we are preparing monomers and model compounds which contain strong electron withdrawing groups to study the effect of stabilization on conductivity. To prepare high molecular weight materials, we are preparing non-conducting segments to polymerize with the above conducting segments. These materials should have higher stability and more useful properties which can be tailored by composition of the resulting block copolymer.

e. Significant Results During Last Year

In our last report we indicated that low molecular weight model compounds have a high conductivity, since that time we have found an error in our measurements and these compounds do not have the earlier reported conductivities. However, serendipity was with us, we did find several low molecular weight systems that do have high conductivities. These anions have unusual structures, in that they have either formed in situ or by addition neutral species of the same structure. This is evidently necessary for flow of electrons (not all of the orbitals are filled which cause mixed valence states). We have now prepared a comprehensive series of low molecular weight compounds as delocalized carbanions and plan to publish the results shortly.

We have prepared several nitro containing model compounds. The conductivities of these first samples are in the semiconductor range, however, they are stable to air and water for extended periods of time. We are now preparing high molecular weight analogs to these model compounds to investigate their conductivity.

f. Brief Summary of Plans for Next Years Work.

The proposed research during the next year is aimed at solving several critical problems in the conducting polymer field. These problems include: the intractability of the known conducting polymers and many of their precursors, their susceptibility to oxidation, their poor mechanical properties and the toxicity of the dopants.

We believe these problems can only be solved by the preparation of new materials and the subsequent study of these materials by an interdisciplinary approach. We will be working in the following areas to address these problems:

1. The synthesis of new conducting precursors (both high and low molecular weight), which are not completely conjugated. These materials will be doped by proton abstraction and their conductivities measured. We will be continuing our work on mixed valence state compounds. If funding on our DOD equipment proposal is approved we will be performing oxidations of multicharged anions, which should yield highly conductive materials.

2. The stabilization of the delocalized carbanions with strong electron withdrawing groups will be continued. We will be looking for an effect on conductivity as well as reactivity based on placement of the electron withdrawing group on the delocalized carbanion framework of high molecular weight systems.

3. The preparation of segmented block copolymers which contain segments from above and non-conducting segments. Initially we will use polyethers (stable to the anion), as the stabilized structures become available we will be able to use other polymer segments. The resulting high molecular weight polymers will be studied for both their conductive and mechanical properties..

g. List of Names of Graduate Students and Post-doctorals Currently Working on this Project.

Graduate Students

Lawrence Hancock

M.S. Thesis Title " Studies in Conducting Polymers: Oxidation of Polyactylene, Proton Abstraction as a Route to Conducting Polymers", May 1986.

Ph.D. Thesis Title "On the Electrical Properties of Delocalized Carbanions", May 1988

Paul Hans

Brian Hilker

M.S. Thesis Title "Nitro-stabilized Proton Abstraction Doped Model Compounds as Precursors to Conducting Polymers", August 1987

William Swatos

h. Technical Reports Submitted to ONR during the Past Year.

L. F. Hancock, B. Hilker, W. Chapman and B. Gordon III, "Proton Abstraction as a Route to Conductive Polymers" Technical Report #1, July 1987.

L. F. Hancock and B. Gordon III, "Proton Abstraction as a Route to Electrically Conducting Polymers" Technical Report #2, July 1987.

P. J. Hans and B. Gordon III, "Wittig Synthesis or Conductive Segmented Block Polymer Compositions" Technical Report #3, July 1987.

B. L. Hilker, J. A. Hancock, L. F. Hancock and B. Gordon III, "Nitro-stabilized Proton Abstraction Doped Model Compounds as Precursors to Conducting Polymers" Technical Report #4, July 1987.

L. F. Hancock and B. Gordon III "Conductive Materials Based on Delocalized Anions" Technical Report #5, July 1987.

P. J. Hans, L. F. Hancock, B. L. Hilker and B. Gordon III, "Studies in Conducting Polymers: Proton Abstraction to Delocalized Carbanions" Technical Report #6, July 1988.